Cedar Avenue Bridge
Delaware, Lackawanna & Western Railroad
Scranton
Lackawanna County

HAER No. PA-132J

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Historic American Engineering Record
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# HISTORIC AMERICAN ENGINEERING RECORD

## Delaware, Lackawanna & Western Railroad: Scranton Yards
## Cedar Avenue Bridge

HAER NO. PA-132J

LOCATION: Over Cedar Avenue at Railroad Alley, Scranton, Lackawanna County, Pennsylvania

UTM: 18/44447/458378
QUAD: Scranton

DATE OF CONSTRUCTION: 1906

ENGINEER/ ARCHITECT: Lincoln Bush, chief engineer

CONTRACTOR: Fort Pitt Bridge Co., Pittsburgh, Pa.

PRESENT OWNER: United States Department of the Interior, National Park Service

PRESENT USE: Not in use.

SIGNIFICANCE: The Cedar Avenue Bridge, once called the Mattes Street Bridge, is typical of the plate girder and concrete railroad bridges erected by the D,L & W after the turn of the century. It carried passenger and freight traffic between the low-lying central Scranton yards and higher grades to the east.

HISTORIANS: Kathryn Steen and Amy Slaton
Delaware, Lackawanna & Western Railroad: Scranton Yards Recording Project, 1989

## INTRODUCTION

The Cedar Avenue bridge, once known as the Mattes Street bridge, carried the freight and passenger tracks of the Delaware, Lackawanna and Western Railroad over Cedar Avenue in Scranton, Pennsylvania. The bridge is located on the eastern edge of the Scranton yards, just west of the passenger station. The freight and passenger tracks actually ran on two separate, adjacent plate girder bridges. The passenger tracks, located on the north side, are at a higher lever than the freight tracks.

## PLATE GIRDER

The passenger track bridge is a deck plate girder bridge, while the freight track portion is a through plate girder bridge. In a deck bridge the plate girders are completely beneath the deck of the bridge and interfere less with the train driver's field of vision. With through plate girders, where the deck of the bridge rests on the bottom flanges of the girders, most of each girder is located above track level. While the through plate girder allows less clearance for the trains, it grants more clearance underneath the bridge.[1] The freight tracks over Cedar Avenue are at a level too low to use a deck plate girder and still allow adequate space for the vehicular traffic below.

Plate girder bridges came into wide use in the late nineteenth century as steel processes improved. The basic open hearth furnace and improved rolling techniques allowed steel girders to be mass produced economically. The simplicity of the design, manufacture, and maintenance made plate girders the bridge material of choice for railroads. Plate girders were used over spans of 20 to 110 feet.[2]

## STRUCTURE

The deck plate girder bridge over Cedar Avenue is supported by four plate girders resting on concrete abutments. Each of the tracks on the deck is supported primarily by two girders. The girders are laterally braced in pairs. Each pair of girders is free to accommodate loads from its respective tracks.[3] The lateral bracing consists of a Warren trussing arrangement of horizontal supports at the upper and lower flanges of the girder. The horizontal lateral supports are periodically supplemented with vertical braces. Lateral bracing is necessary to make the bridge rigid enough to withstand horizontal forces caused by the acceleration and braking of locomotives.[4]

As a through plate girder bridge, the freight bridge has a different flooring system from that of the passenger bridge. The freight bridge has two tracks. Though maximum stability was achieved if each track rested on two girders, this would have meant that the Cedar Avenue freight bridge would have had four girders, making it a wider more expensive, structure.[5] Provision of three girders for two tracks was deemed sufficient for the Cedar Avenue bridge, and thus only one girder stands between the two tracks, sharing the load of both tracks. The deck of the bridge is formed by a series of crossbeams resting on the lower flanges of the three plate girders. The crossbeams are made of riveted steel plates, and eliminate the need for additional lateral support.[6] A steel plate to support the rest of the floor is riveted above the crossbeams.

Above the deck there are five gusset plates, or knee braces, supporting the top flanges of the girders. A gusset plate is simply a triangular brace reaching from the top of the girder to a point at deck level about one foot from the girder. Also along the girders are vertical intermediate and end "stiffeners" to make the web of the girder more rigid.[7]

Both the passenger and freight bridge have solid, reinforced concrete flooring laid over steel plates and supporting members. Solid decks, as opposed to open decks where the ties are laid directly on the supporting girders, prevent debris from dropping below the bridge. More importantly, a solid floor prevents the rails from shifting, provides a smoother ride and makes maintenance easier.[8] The passenger bridge has catwalks with guard rails on either side.

The passenger and freight bridges at Cedar Avenue were constructed in 1907-1907 by the Fort Pitt Bridge Company of Pittsburgh and erected by the D,L & W's own forces.[9]

SUBSTRUCTURE

The span of the Cedar Avenue Bridge rests about 21 feet above street level on the passenger-track side, and about 14 feet above the street on the freight-track side. All the girders rest on concrete abutments, which in turn rest on masonry retained from an 1860 bridge on this site.[10] The upper portion of the original masonry abutments was removed when the current bridge was built.[11] The concrete abutments are of the "breast" type, comprised of the breast itself, which directly supports the bridge's superstructure, and acts as a retaining wall for adjoining infill, and the "backwall," a gently sloped wall behind the breast that prevents retained material from encroaching on the bridge seat, or shelf.[12] Foundations for the abutments extend five feet below the original street level.[13]

The "wings" of concrete bridge abutments are the portions that extend from either side of the breast. In most abutments, these wings usually extend at an angle away from the street. The wings of the Cedar Avenue Bridge are parallel with the street, an arrangement that probably derived from the fact that the bridge was built in the context of other retaining walls and installations that determined its shape; it is part of the long incline the D,L & W constructed over many years to carry trains from the low-lying yards up grades to the east. On its north end, the bridge's west abutment meets the "China Wall," a high concrete retaining wall that runs along the north edge of the D,L & W's Scranton property. (This wall existed in the nineteenth century, but was improved in 1907. It runs uninterrupted except where it allows street traffic to pass under the bridge at Cedar and Washington Avenues.[14]) On its south end, the west abutment retains fill on which were constructed a water tower (destroyed) and the Mattes Street Signal Tower (built 1908, still standing). The bridge's northeast abutment wing meets the D,L & W freight offices of 1908. The bridge's southeast abutment meets the east-west retaining wall above the old Laurel Line trolley terminal to the south.

The concrete of the Cedar Avenue bridge is now somewhat deteriorated, but this is probably due in part to the limited maintenance provided to the structure since the D,L & W dissolved in the 1960s. The railroad was known for its work with concrete, starting in 1902 when William K. McFarlin, the first chief engineer hired by D,L & W President Truesdale, supervised the construction of concrete bridges, abutments and retaining walls for the elimination of grade crossings at Newark, New Jersey. In 1903, the D,L & W built a 40-foot concrete arch to replace a masonry structure at Bridgeville, New Jersey, and shortly thereafter used concrete in the foundations, floors and subways of their Keyser

Valley and Kingsland shops. The railroad's first use of reinforced concrete was in their coal trestle at Hoboken, New Jersey in 1906. From 1908 to 1911, reinforced concrete was used in the viaducts, culverts and bridges of the D,L & W's New Jersey cut-off. By 1912, the railroad was using concrete for everything from signal towers to fence posts, and had gained the nickname, "the reinforced concrete railroad."[15]

The use of concrete for industrial purposes in the U.S. had been steadily expanding since scientific research on the material began in earnest in the 1870s.[16] The D,L & W's large scale adoption of concrete just after the turn of the century was no doubt a result of President Truesdale's vast modernization agenda. One architecture critic explained in 1913 that the D,L & W used concrete for its structures because brick and building-stone were not always available along the lines of the railroad, and were expensive to transport. The writer blithely added that the use of brick and stone also "require the services of workmen who...must be brought from a distance, maintained and paid a rate of wage based on supposed but not always realized efficiency."[17] Though the D,L & W probably did want to save labor costs, this explanation of their employment of concrete does not suffice: chief engineer Lincoln Bush (1903-1909) used reinforced concrete in his innovative "umbrella" train sheds, which were a radical departure from earlier kinds of sheds, not merely an inexpensive substitute. Further, the D,L & W's elaborate researches on concrete point as much to an interest in flexible and reliable materials as to cheap ones.

In laboratories at their Scranton yards, the D,L & W tested concrete for fineness and setting time, and subjected samples to "autoclave tests" for tensile strength (more rigorous than the conventional "boiling test"), and "digestion tests" in steam and hydrochloric acid. The company developed specifications that differed from those of the American Society of Civil Engineers, the American Institute of Architects and the Engineer Department of the U.S. Army.[18] The D,L & W also maintained rigorous inspection policies. All purchased cement was carefully inspected at the mill, and when materials were sent to the D,L & W, shippers were required to "furnish the [D,L & W's] chemist and engineer of test with analyses and physical tests showing results obtained upon the bin from which shipments are made."[19] This testing was apparently worthwhile because, though early concrete structures like the 1902 New Jersey retaining walls required repair by 1912,[20] many other concrete structures of the D,L & W, including the massive Tuckhannock Viaduct (built in 1915 with 150,000 cubic yards of concrete), are still in use.

NOTES

1.Railway Engineering and Maintenance Cyclopedia, third edition (New York: Simmons-Boardman Publishing Company, 1929), 511; and F.C. Kunz, Design of Steel Bridges, first edition (New York: McGraw-Hill Book Company, Inc., 1915), 145.

2.J.A.L. Waddell, Bridge Engineering, 2 volumes, first edition (New York: John Wiley and Sons, Inc., 1925), 46-47, 408; and Cyclopedia, 507; and Charles Lee Crandall and Fred Asa Barnes, Railroad Construction (New York: McGraw-Hill Book Company, 1913), 239.

3.Kunz, 145.

4.William Guy Williams, I-Beam and Girder Plates (Scranton, Pa.: International Textbook Co., 1947), 4.

5.Kunz, 147.

6.Kunz, 166.

7.Cyclopedia, 523; and Kunz 157.

8.Cyclopedia, 532-534; and Williams, 2,5.

9.Interstate Commerce Commission, "Inventory Schedule of Structures," Valuation Section 21, Account No. 6, (December 10, 1919), 72.

10.I.C.C., "Inventory," 72.

11.Delaware, Lackawanna and Western Railroad Company, "Masonry Plan for Bridge over Mattes Street, Scranton, Pennsylvania," December 5, 1905, (plan), Steamtown National Historic Site, Scranton, Pennsylvania.

12.Cyclopedia, 447-448.

13.D, L & W, "Masonry Plan," (plan).

14.A. Berle Clemenson, Historic Resource Study: Steamtown National Historic Site (Denver:National Park Service, Denver Service Center, 1988), 127.

15.Railway Age, October 14, 1922, 705; and "New Delaware, Lackawanna & Western Specifications for Portland Cement," Railway Age Gazette, Vol. 54, No. 4.

16.Ada Louise Huxtable, "Concrete Technology: Historic Survey," Progressive Architecture, October 1960, 147.

17."The Architectural Treatment of Concrete Surfaces," American Architecture Vol. CIV, No. 1978 (November 19, 1913), 193.

18."New Specifications."

19."New Specifications," 158.

20."Patching Concrete Retaining Walls by a Concrete-Spraying Machine," Engineering News, Vol. 72, No. 15, 744.

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